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Electronic Ticketing in Public Transport: A Field Study in a Rural Area

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The NoordNed Mobile Ticketing service (in this article referred to as M-Ticketing) is an early example of electronic ticketing in the Netherlands. Using this service, customers no longer need to buy a ticket at a ticket office or ticket machine. Instead, people can order M-Tickets through the Internet or by calling a voice response system and receive their M-ticket on their mobile phone through the Short Message Service (SMS).

This article describes the innovative aspects and customer expectations of the service offered. Consumer adoption of the service was evaluated by conducting a field study. It appears that the service is most attractive for semifrequent public transport users. The participants were also asked for their willingness-to-pay (WTP) for additional mobile services. This WTP level turned out to be rather low so we must conclude that it would be difficult to develop additional services as a profit center in order to make the ticketing commercially feasible. The most interesting additional service was en-route real-time travel information. A regression analysis of WTP for this service revealed that it depends positively on features of travel behavior such as the number of transfers per trip.

Keywords Railways; Mobile Services; Public Transport; SMS; Electronic Ticketing

The introduction of electronic ticketing has various advantages for travelers and transit companies. For travelers, there is no need to queue at ticket machines and ticket offices. Further, it involves payment via direct debit and online accounting on the traveler's personal page. For suppliers, it may reduce ticketing costs and opportunities for value added services are created. Moreover, the supplier will be able to monitor the actual traveler's behavior more closely. In addition, electronic ticketing yields possibilities for more flexible fares, offering, for example, opportunities to transform a zone-based fare system into a distance-based one. Another opportunity is the creation of flexible subscription rates, for example, intermediate rates between those for weekly-based and monthly-based season tickets. According to Buellingen and Woerter (2004), mobile ticketing combines some ". . .very important features of mobile communications: comfort, spontaneity and mobility" (1406). Of course, there are also various disadvantages of electronic ticketing, such as vulnerability to technical failures, and the investment costs associated with the introduction of the system.

Electronic ticketing can be described as obtaining a *virtual/electronic* proof of access/usage rights to a service instead of obtaining a tangible ticket. In this article, "mobile ticketing" is electronic ticketing enabled by mobile phones. In the NoordNed Mobile Ticketing service studied in this article (referred to as M-Ticketing), the proof of an M-ticket being valid resides in ticket authentication by the server. Clearly, this requires an online connection to the ticket issuer's server at the usage point (i.e., in the trains). Such tickets are analogous to airline e-tickets.

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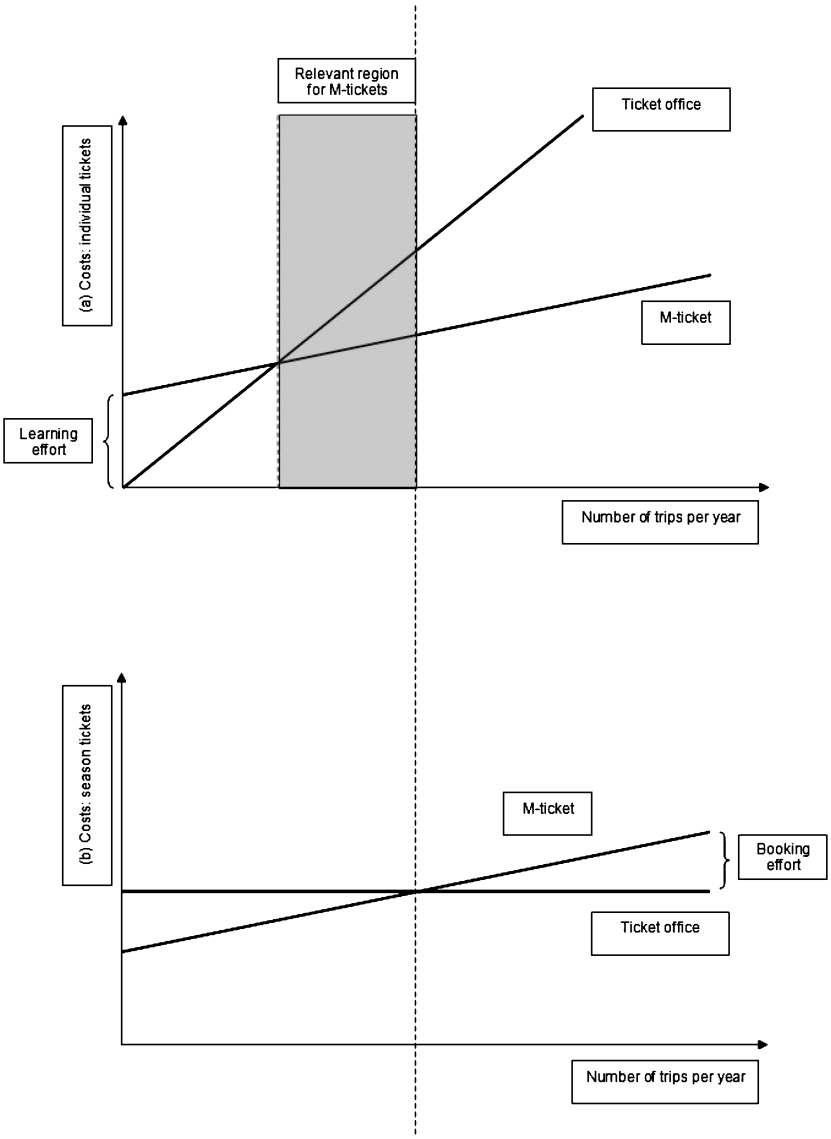

Figure 1 Ticketing costs: (a) individual and (b) season tickets.

A recent survey of electronic ticketing in public transport (Eugenia et al., 2002) demonstrates that the adoption of electronic ticketing is a major issue in many countries. In public transport, the applications are mainly concentrated in densely populated urban areas (e.g., the Octopus smartcard system in Hong Kong) where the return on investment on electronic ticketing is highest. In 2001, the Helsinki Transport Company (www.hel.fi/hkl) successfully introduced mobile ticketing in public transport. By sending a text message a traveler can buy a single ticket that is valid for one hour on trams, the metro, and the Suomenlinna ferry (but not on buses). The service was expanded in November 2004 to include widening the geographical coverage of the mobile service, increasing the number of participating telecom operators and "...introducing a new time-based tariff ticket, enabling passengers to use mobile ticketing also during the night tariff..." (Helsinki Transport Company, 2001).

In aviation, the emergence of low cost carriers bears resemblance to electronic ticketing (Mason, 2000) and this has strong impacts on distribution channels. In the meantime, electronic ticketing has also become widespread among incumbent carriers. The difference between aviation and urban public transport is that, in the former, electronic ticketing is connected to the reservation of places in order to ensure occupancy rates below 100%. Similar developments can be observed for long-distance rail transport. However one market segment where the introduction of electronic ticketing has been slow is rural areas; the reason being the lower rate of return on investment there.

A major question concerns the market potential of the M-ticket service. This is illustrated in stylized form in Figure 1a and 1b. Figure 1a shows that if a traveler buys only a few tickets over the course of a year, the use of M-tickets is probably not worthwhile: although the use of the Internet and Voice-portal to

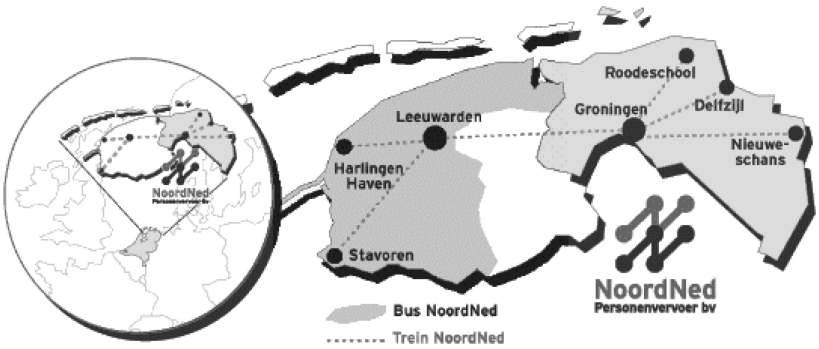

Figure 2 Operating area of NoordNed (www.noordned.com).

order tickets is free, there is still a learning effort involved. On the other hand, when a traveler uses public transport on a daily basis (see Figure 1b), it makes more sense to buy a season ticket, so in that case, too, there is not much reason to use an M-ticket. Hence, it is in the intermediate cases that the M-ticket service is an interesting proposition. Where exactly the cutting points are between a preference for M-tickets and for those purchased at the ticket office depends on personal characteristics and preferences.

In this article, we discuss a study on the introduction of electronic ticketing in sparsely populated areas. The case study region is in the Northern part of the Netherlands and, apart from one bus line, it deals with short- and medium-distance rail transport. To date, initiatives in the field of electronic ticketing have been limited in the Netherlands. Some pilot studies of limited size have been carried out in urban areas, but the ambition to introduce a nationwide standard for all modes and companies involved has led to long delays. At the start of the NoordNed Mobile Ticketing project (September 2002), there was as yet no certainty of an agreement between major players.

The M-Ticketing implementation relates to a low-cost investment strategy, whereby travelers make advance reservations of their tickets, which they receive on their mobile phones via the SMS. The implementation, which took place between September 2002 and May 2003, was extensively monitored (for details, we refer to Dekkers, 2003). In this article, we use the results of the monitoring activities for a careful examination of the implementation and the potential weaknesses and opportunities of this approach. Special attention is also paid to the WTP for additional services linked to the M-Ticketing service.

DESIGN OF THE NOORDNED MOBILE TICKETING STUDY

In the Netherlands, all the railways used to be run by Netherlands Railways (Nederlandse Spoorwegen [NS]), a state-owned enterprise. At one time, students had a public transport pass called the "studenten-OV-jaarkaart," which enabled them to freely use public transport services seven days a week. Students are mentioned here specifically because they form a large group of customers. Most students do not own a car and are dependent on public transport. During the 1990s, a start was made with the privatization of NS and the train services. Since 1999, three passenger operators have been offering their services to the public: NS, still by far the largest service provider, Syntus, and NoordNed (see Figure 2). In addition, strong government budget cuts caused a change in the conditions of use for the free public transport pass for students: they are still allowed to travel for free by public transport but now either on working days or during the weekends instead of seven days a week.

The NoordNed M-Ticket service is a network application in which registration, management and personal overviews are published via the Internet (Hünteler, 2003). An M-Ticket can combine bus and train tickets all in one. Participants can order their M-Tickets through the Internet or by calling a voice response system: Voice-portal. On the day of their journey, travelers receive their M-ticket through the SMS on their mobile phone. The control officer on the train or bus can check the validity of a ticket using a handheld computer (PDA) with a fast mobile telephone network connection (General Packet Radio Service [GPRS]) to the central database (see Figure 3). Some time in this checking process can be gained because people on average need less time to fetch their mobile phone than to look for their tangible ticket, but checking the virtual ticket through the GPRS-connection will take more time. In general, checking a virtual ticket will take more time; the functional specifications of the NoordNed M-Ticket Service define a maximum time allowed for checking tickets of 45 seconds per M-Ticket, which must be considered as a soft standard. Payment is made via direct debit on a weekly basis.

Most tickets that are available at the ticket office can also be bought with the M-Ticket service (see Table 1). There were no extra restrictions on the period within which travelers would have to use the M-tickets.

The relative cost of providing the M-Ticket service versus traditional ticketing is described by Hünteler (2003). He estimates the costs of traditional ticketing on approximately 0.25 eurocents per ticket. These costs are calculated as a fixed percentage of the average ticket price. The variable costs of an M-Ticket booked through the Internet are 50% lower, which makes it commercially interesting. Taking the fixed costs of the M-Ticket service into account, the break-even point of this service is reached when

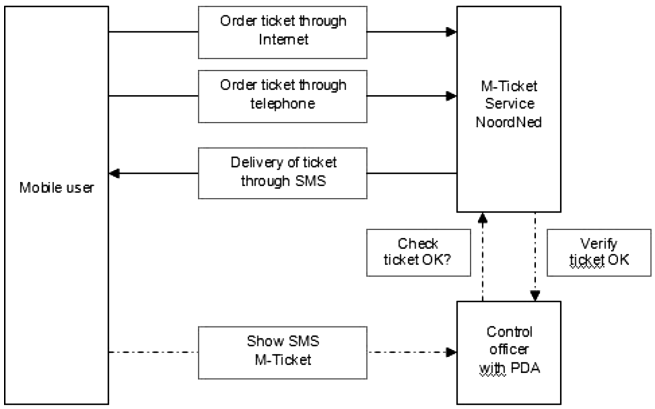

Figure 3 Flowchart of the M-Ticket service (adapted from Van den Akker, 2003).

selling around 27,000 M-Tickets per month. The variable costs of the Voice Portal are almost twice as high as the costs of traditional ticketing, which means this service is not profitable when offered through a free 0800-number. When the service is offered for (at least) 0.25 eurocents per call, the Voice Portal service also becomes profitable.

A field study with a test group of more than 100 customers was set up in order to test both the technical and the functional aspects of the M-Ticket service. Each participant had to possess a mobile phone and had to travel regularly on at least one of the public transport routes that were selected for the field study.

The first aim of the field study was to test the technological features of the mobile ticketing system by means of using it in a real-world context. In addition, users were followed in their use of the ticketing system and asked for their satisfaction with various features of the system. Therefore, the second aim of the study was an assessment of the system's market potential. The third aim was to formulate recommendations to improve the system.

Before and after the study period, participants were asked to fill in questionnaires. The first questionnaire contained questions related to income, gender, age, interests, travel patterns, and expectations of the M-Ticket service. The second questionnaire was meant to evaluate the system implementation, by measuring the customer's opinion on all aspects of the service.

Table 1 Type of tickets available at the ticket office and with the M-ticket service

	Available at:	
Type of public transport ticket/pass	*Box office*	*M-Ticket service*
One way ticket	yes	yes
One way ticket, reduced-fare (−40%)	yes	yes
Return ticket	yes	yes
Return ticket, reduced-fare (−40%)	yes	yes
Weekend return-ticket	yes	no
Five-journey return ticket[1]	yes	no
Month-ticket, fixed route	yes	yes[2]
Youth month-ticket, fixed route	yes	yes[2]
Month-ticket, all routes	yes	yes[2]
Youth month-ticket, all routes	yes	yes[2]
Year-ticket, train only	yes	no
Year-ticket, all public transport	yes	no
Reduced-fare season ticket[3]	yes	no
Summertour ticket, multiple days, all routes	yes	yes
Wadden-ticket, for train, bus & boat over the Waddensea	yes	yes
Season tickets (week/month/year)	yes	yes[2]
Season tickets (week/month/year), reduced-fare (−40%)	yes	yes[2]

[1]Buying a set of five return-tickets at once gives the traveler a small discount.
[2]The M-Ticket service also offers a more flexible type of subscription. For example, it can also offer a monthly subscription, but if the traveler has a day off, he/she can cancel the M-Ticket for that day and pay nothing. Since the normal subscription fee is the maximum fee, the M-Ticket service can be cheaper for the customer.
[3]This ticket entitles the traveler to a 40% discount on all train tickets, valid from 9 a.m. onwards.

EX-ANTE SURVEY: USER CHARACTERISTICS

The participants were randomly recruited via flyers and posters in all NoordNed trains, at ticket offices and some colleges and via articles/announcements in magazines. In addition, a mailing was sent to: (1) *all* NoordNed customers and (2) customers of the Rabobank in the North of the Netherlands. Participation was based on self-selection. The target group for the selection was all NoordNed customers, regardless of age, gender, income, etc. Tables 2a–2c contain the percentage distribution of the major demographic categories.

The sample consisted of 110 participants, which is approximately 1% of the total ridership, based on the average number of travelers per working day on all routes studied (VROM/V&W, Mobility Policy Document [2004]). This sample size was sufficient for the purpose of the study (testing the basic ticketing service and getting an indication of potential consumer demand

Table 2a Percentage distribution of participants by five-year age groups and by gender

Age (Years)	Total	Male	Female
0–10	0.0	0.0	0.0
11–15	0.9	0.9	0.0
16–20	19.1	15.5	3.6
21–25	33.6	20.0	13.6
26–30	14.5	11.8	2.7
31–35	8.2	4.5	3.6
36–40	4.5	3.6	0.9
41–45	4.5	3.6	0.9
46–50	6.4	6.4	0.0
51–55	5.5	4.5	0.9
56–60	1.8	1.8	0.0
61–65	0.9	0.9	0.0
65 and over	0.0	0.0	0.0
ALL AGES	100.0	73.6	26.4

Table 2b Percentage distribution of participants by type of employment and by gender

Type of Employment	Total	Male	Female
Scholar or student	42.7	30.9	11.8
Business	28.2	23.6	4.5
Government	6.4	3.6	2.7
Health care and Education	10.9	8.2	2.7
Other	8.2	4.5	3.6
Housewife or -husband	0.9	0.0	0.9
Retired	0.0	0.0	0.0
Incapacitated for work	0.9	0.9	0.0
Unemployed	0.9	0.9	0.0
Not answered	0.9	0.9	0.0
TOTAL	100.0	73.6	26.4

for the M-ticketing technology). However, the sample size was not always large enough for the outcomes to be statistically significant. During the recruitment period, most, if not all, of the NoordNed customers had heard, at least once, about the M-Ticketing project and the possibility to participate.

When asked why they had decided to participate in this study, 49% of the participants said they wanted to buy their tickets in another way, 44% wanted to see if this service really worked, 41% were interested in new services; and 30% in new technologies. Most of the participants in the study (44%) were students and schoolchildren, so they were young and had a low income. Another 28% were employed and 33% had a degree.

Most participants were male and aged between 16 and 30. Only three of the participants above the age of 35 were female. Young males were not specifically targeted in the recruitment process. So this specific bias in age and gender is a strong indication that especially young people (males) are heavy users of mobile phones and interested in new mobile services. Compared with the general customer profile of NoordNed (www.noordned.com), the sample's age distribution was representative, but the gender distribution was biased towards males: 58% of the NoordNed customers are female (NoorNed Personenvervoer BV, 2004).

The kind of public transport tickets and passes that participants used before the field study are described in Table 3. These percentages add up to more than 100 because people who own a special 40%-discount card sometimes also buy single tickets at the normal rate (e.g., when traveling before 9 a.m.). The same line of reasoning applies to students: when they own a student card for free public transport during the weekends, they will have to buy a regular or 40%-discount ticket when they travel on working days. Noteworthy is the relatively large percentage of travelers with a five-journey return ticket valid until one year after the next ticket fare change. This could very well be an indication that a relatively large proportion of the participants worked part-time because if they would be working full-time, they would be better off with a season ticket. Note also that holders of season tickets (monthly or annual) were not represented in the study. This underlines that the major users of the M-ticket service can be found in the segment of *semiregular* users. The 40%-discount card is also targeted for this group, and student cardholders will also be in this group: the latter generally do not own a car, and get free public transport during weekdays. This semiregular group is also expected to travel by public transport during the weekend rather frequently, and they may therefore opt for M-tickets.

Table 3 Type of public transport ticket that participants used before the M-ticketing implementation

Type of public transport ticket/pass	Percentage of participants
Single and return tickets	74
Student card for free public transport on working days	38
40% discount card valid from 9 a.m. onwards	38
5 × return ticket	17

Figure 4 gives more insight into the number of journeys that participants made on average. The group of persons with high trip frequency (four days or more per week) consisted of students (48%) and of people working for companies (39%), for the health or educational sector (10%) or for the government (3%).

Table 4 shows the participant's estimated guess of the ticket check frequency. According to this table, on average, travelers expected to experience a check on about 17–18% of their trips. One of the interesting features of the M-ticket service is that the

Table 2c Percentage distribution of participants by level of income and by gender

Level of Income (in euros)	Total	Male	Female
No own income	11.8	7.3	4.5
Less than € 7.500	29.1	22.7	6.4
€ 7.500 up to € 15.000	18.2	7.3	10.9
€ 15.000 up to € 25.000	20.9	16.4	4.5
€ 25.000 up to € 40.000	11.8	11.8	0.0
€ 40.000 and over	4.5	4.5	0.0
Not answered	3.6	3.6	0.0
TOTAL	100.0	73.6	26.4

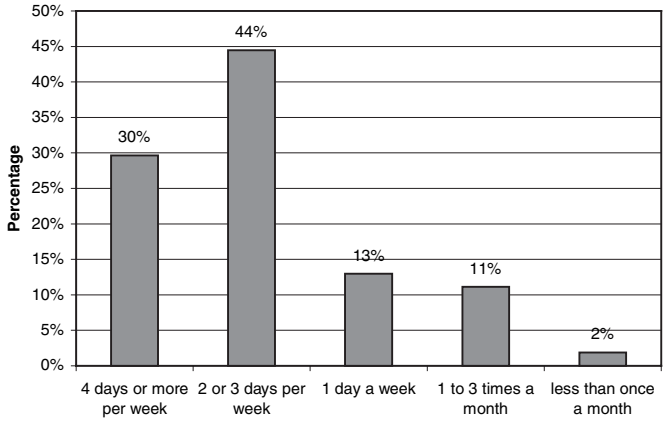

Figure 4 Trip frequency of participants using public transport.

Table 4 Check frequency: travelers' estimates

Estimated check frequency	Percentage of participants (%)
Almost never	50
Once every ten trips	20
Once every five trips	16
Once every two trips	8
Once every trip	5
More than once per trip	1

real number of checks is recorded. This appears to happen on 20.4% of all trips. Thus, perception and reality were not far apart. This also offers an illustration of the use of mobile tickets for transport companies: these tickets clearly enable the company to monitor its activities more closely.

Because the M-Ticket technology uses the Internet and mobile phones it was important to know the participant's experience and behavior in terms of Internet use, mobile phone use, and text messaging using their mobile phone (SMS). Of the respondents, 49% used the Internet more than one hour per day (see Figure 5). This was a relatively high percentage compared with that for the average Dutch citizen. A possible cause of this discrepancy is the fact that 46% of this group are students. Of the participants, 72% used the Internet on a daily basis, and 65% made payments through the Internet.

With regard to using their mobile phone, 50% used their phone at least once a day, and 39% used it one to five times a week (see Figure 6). Similar high values were found for SMS use.

Before starting to use the M-Ticket service, 34% of the participants bought their bus tickets at the Railway ticket office, 29% bought them in a shop (e.g., newsagent's or tobacconist's), and 18% went to the post office. Of the participants, 33% indicated they were dissatisfied with the railway ticket machine because it does not sell bus tickets as well as train tickets. The overall conclusion is that a considerable proportion of the respondents experienced difficulties with buying bus or tram tickets the regular way. This problem seems to be greater in rural areas than in urban area, which demonstrates the relevance of this case study.

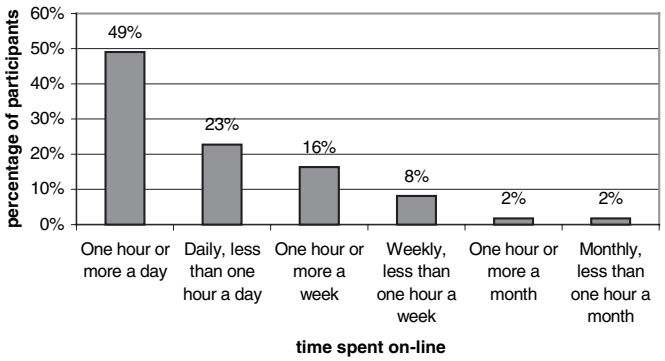

Figure 5 Frequency of using the Internet.

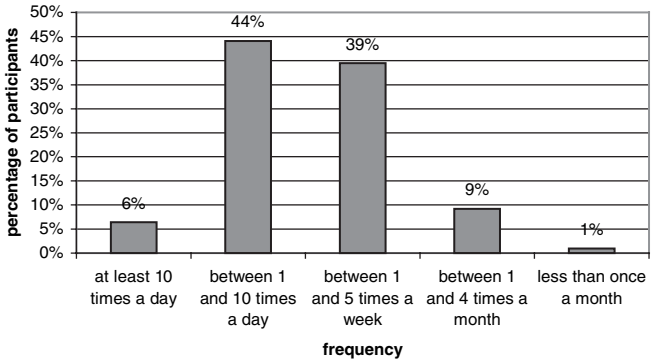

Figure 6 Frequency of using a mobile phone.

EX-POST SURVEY AND DATA ANALYSIS

Participation Growth Rate

When looking at the changes in participation in the field study over the course of time (see Figure 7), it is clear that particularly in the early stage (weeks two to six), the number of new participants per week was high. In October (weeks seven to ten), the number of new participants has already decreased and, except for a hiccup in the second half of November (week 13), it remained rather stable during the rest of the study. This pattern can be explained by the marketing activities of NoordNed which were intensive during the start-up period (weeks 1 and 2) and also in week 13 when a mailing was sent out to customers of the Rabobank in the North of the Netherlands.

During the complete period, 1,661 tickets were sold to 71 of the 110 participants who filled in the questionnaire: during that period 39 participants did not travel at all, and therefore did not buy a single M-Ticket. On average, an active (traveling) participant bought 23.4 tickets during the field study period, adding up to a total average amount spent on tickets of €107.46 per participant. During the course of the study, there were another 86 new users of the NoordNed M-Ticket service on top of the 110 participants who filled in the questionnaire, which brought the

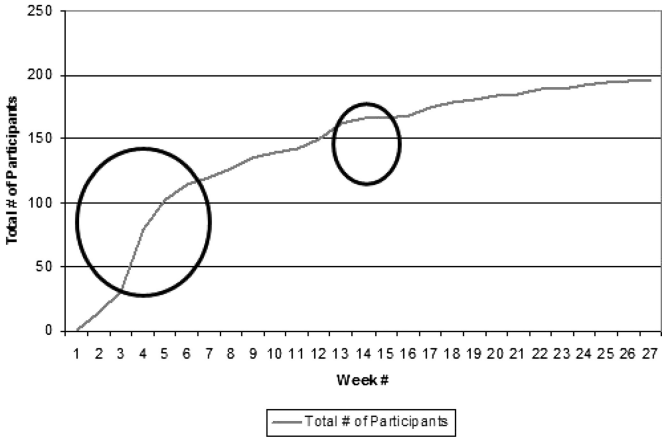

Figure 7 Increase in number of participants in field study, September 2002–February 2003.

total number of users of the M-Ticket service to 196 at the end of the study. The top 40 users of the M-Ticket service bought, on average, 5.7 M-Tickets per person per month.

Reliability of the Service

During the first part of the study (September 2002–January 2003), 1,023 M-Tickets were sold, with an average price of €5.43 (Hünteler, 2003). Of these tickets, 52 were not received in time, which is a failure rate of about 5%. This can be considered very high for a mobile ticketing service. The main cause of this failure was an error in sending the "batch-SMS" at 5 a.m. This batch consisted of M-Tickets that were bought in series: for example, one traveler bought 30 M-Tickets at once (for a whole month). Then, every morning he/she received the M-Ticket for that day automatically at 5 a.m.

Most of the participants who were confronted with this shortcoming felt very uncertain and frustrated when this happened. They did not know what to do: take the train anyway and risk a fine or buy a regular ticket to be certain and then try to get their money back afterwards? In fact, the control personnel could check at all times in the database whether a person had indeed purchased an M-Ticket or not. Not every employee was aware of this, which caused some unnecessary anger with travelers being fined wrongfully.

After January 2003, the batch-processing error was corrected, which caused the failure rate to decline considerably to an acceptable level for this type of service. In the ex-post survey, 57% of the participants indicated that they had never received an SMS too late.

Ease of Use

Travelers were asked to rate buying a ticket the regular way and 'the M-ticket way' (see Table 5). Long waiting times at the train ticket machines and offices and uncertainty about waiting time were the main sources of dissatisfaction with buying tickets the regular way. People were also dissatisfied because it is not possible to buy a ticket at the ticket office using a bankcard. In principle, the M-Ticket innovation offers a solution for these problems, which is supported by the figures from the table above.

Table 5 How easy is it to buy a public transport ticket? (percentage of respondents)

How easy is it to buy a ticket?	Buying a bus ticket the regular way		Buying a train ticket the regular way		Using the M-Ticket Website		Using the M-Ticket Voice-Portal	
	(%)	(cum.)	(%)	(cum.)	(%)	(cum.)	(%)	(cum.)
Very easy	7	7	6	6	47	47	41	41
Easy	56	63	69	75	53	100	56	97
Difficult	28	91	24	99	0	100	3	100
Very difficult	9	100	2	100	0	100	0	100

Table 6 Disadvantages experienced with the M-Ticket service

Mentioned disadvantages of the M-Ticket service	Number of times mentioned (%)
I do not experience any disadvantages	28
An M-Ticket can not be canceled or edited on the day of traveling	13
The M-Ticket service is restricted to only the north of the Netherlands	11
Uncertainty whether the SMS will arrive in time	9
I cannot order a weekend return ticket or a batch of 5 return tickets for a certain route	9
I do not have a receipt for declaring my trip	9
Checking the ticket takes more time, is more laborious	9
The M-Ticket service does not always work/the Internet site does not always work	7
I do not have a ticket if I forget my cell-phone or if the battery is empty	7

Nevertheless, one should be aware that these figures are given by participants, and because participation was based on self-selection it is no surprise that the M-ticket was performing well compared with the traditional ticket system. However, one can at least say that there is a market segment for which M-tickets are clearly superior to traditional tickets.

It is also important to consider the disadvantages people mention concerning the M-Ticket service (see Table 6). The largest group of the participants (28%) said they did not experience any disadvantages. Uncertainty about whether the service would work and whether the SMS would be received in time were mentioned as possible disadvantages.

Of the participants, 58% indicated that they liked or very much liked the fact that their personal ticket history on the Internet gave them insight into their travel expenses with public transport. Therefore, the disadvantage of not having a receipt to verify that they have paid for the trip can be tackled easily using this personal ticket history.

The problem of a forgotten cell-phone or depleted battery can also be overcome, since the personnel can look in the database to see whether a certain user has bought a ticket. Communication with travelers is important to remove these problems.

Willingness-to-Pay, Additional Services

Of the travelers, 30% ordered M-Tickets mainly through the Internet, 58% mainly through the Voice-portal, and 11% used both these methods regularly. These figures are interesting from an economic point of view, because the Voice-portal is more expensive per ticket than the Internet. It would be advantageous for NoordNed if they could bring about a shift from ordering through the Voice-portal towards ordering through the Internet. This could be achieved, for example, by charging a price for using the Voice-portal.

The Voice-portal was introduced very successfully as a free 0800-service. When asked whether they would continue to use the M-Ticket Service if there was a charge of 25 eurocents per

Table 7 Interest in additional services

Interest in additional services	Percentage of participants
Real-time travel information (about delays, disruptions, etc.)	71
Departure times of buses and trains (according to timetable)	33
Local weather forecast	7
Route-information from the bus stop or station to the final destination	25
Ordering a cab or traincab (discount-cab especially for train travelers)	27
Local and regional news	5
Tourist information about special sites, museums, etc.	2
Other	7

call (noting that in one phone call multiple tickets can be ordered), 68% of the participants stated they would no longer use the M-Ticket service, 11% stated they would continue using the service, and 21% did not know. Ordering tickets through the Internet instead of through the Voice Portal was not explicitly mentioned as an alternative in this question. Clearly, people are price-sensitive at this point: the low WTP for this service means that, in the end, its advantage for the traveler is limited.

For future development, it was interesting to know what kind of mobile services travelers would like, and what kind of services could be offered in combination with the M-Ticket service (see Table 7). It is clear that most of the additional services of interest are related to traveling. Note that the percentage of participants interested was measured as a percentage of the total number of participants, presuming that participants who did not respond to this question (15% of the total number of participants) were not interested in any other service.

In order to get an idea of which additional services are worthwhile introducing, besides the interest in these services, the customer's WTP was also measured (see Table 8). More than half of the participants indicated that they were not willing to pay anything for these additional services. For the local weather-forecast service, this was as much as 97%. This low WTP figure was probably due to the perceived low quality of these forecasts and the ample supply of weather forecast information from competing sources that are free (radio, television). The average WTP per respondent was highest for real-time travel information and route-information to the final destination at 4.45 and 4.55 eurocents per call, respectively. These figures include the people who were not willing to pay anything. The overall conclusion is that the market for additional services is limited, and that the WTP is rather low.

The most promising market segment for additional services is real-time travel-information, since far more people were interested in this service than en-route-information to the final destination (see Table 8). This makes sense, since "travel information [. . .] can minimize the inconvenience of using public transport by making it easier to plan and execute a journey," especially with multi-modal journeys (Lyons and Harman, 2002, 2).

It is appropriate in this type of study to apply sample selection models to model the relation between willingness to use and to pay for such a service (see for example Anspacher et al., 2005). Therefore, a Heckman sample selection model is estimated in which a binary logistic regression and an OLS-regression are estimated simultaneously (Table 9). The two models yield very similar results for the Willingness to pay model. The value for the parameter Rho, representing the correlation between the error terms, is rather low; it is not statistically significant from zero, meaning that the Heckman model does not add much to the separate OLS and binary logit models.

The results for the WTP for real-time travel-information (Table 9) reveal that it increases with income, as may be expected for this type of service. The bèta of income indicates that if for instance a respondent's income is € 20,000 instead of € 10,000, he/she is willing to pay an additional 2.0 eurocents for each time he/she needs real-time travel information. It also increases with the frequency of use of mobile phones, indicating that for instance respondents who on average use their mobile phone more than ten times a day are willing to pay 3.1 eurocents extra for real-time travel information compared to respondents who use their mobile phone between once and ten times each day. Another interesting result is that travelers with complex trips (measured by the number of changes of transport vehicle during a trip) have a higher WTP for travel information: respondents who on average make two transfers per trip per day are willing to pay 4.7 eurocents more for the real-time travel

Table 8 Willingness-to-pay for additional services (in percentages of participants)

		Real-time Travel information		Departure times		Local weather forecast		Route-information to final destination	
	Costs per call (eurocent)	#	%	#	%	#	%	#	%
Interested	50	0	0%	0	0%	0	0%	2	4%
	25	4	7%	3	5%	0	0%	4	7%
	10	10	18%	6	11%	2	4%	4	7%
	5	9	16%	1	2%	0	0%	2	4%
	Nothing	16	29%	8	15%	2	4%	2	4%
Not interested		16	29%	37	67%	51	93%	41	75%
	Total	55	100%	55	100%	55	100%	55	100%
Standardized WTP (in eurocents)		4.45		2.55		0.36		4.55	

Table 9 Models of Willingness to Use and Pay for a real-time travel information service

	Heckman Sample Selection		Independent Models OLS		Logit	
Variable	Coeff	Z	Coeff	Z	Coeff	Z
Willingness to Pay (WTP)						
Constant	−11.437	−1.93*	−11.805	−1.94*		
Income	2.036	2.39**	2.213	2.61**		
Freq. mobile phone calls	3.086	1.84*	2.618	1.62		
Avg. transfers / trip per day	4.684	2.60***	4.800	2.62**		
Willingness to Use (WTU) (1 or 0)						
Constant	0.697	0.82			1.198	0.83
Income	0.067	0.53			0.121	0.59
Freq. mobile phone calls	−0.266	−1.19			−0.459	−1.21
Avg. trips/day	1.869	1.63			3.100	1.46
Avg. transfers/trip per day	0.087	0.38			0.132	0.34
Summary statistics						
Rho	−0.288	−0.70				
Sigma	7.242	7.59				
Lambda	−2.089	−0.67				
Number of obs	62	62	39		62	
F Stat/P>Chi2	0.004		0.011			
Goodnesss of fit			0.20		0.06	
Log Likelihood	−169.9				−38.4	

Note: ***significant at the 1% level; **significant at the 5% level; *significant at the 10% level

information service compared to respondents who only make one transfer per trip per day. This underlines that disturbances in transport chains hurt most when a bus is used as an access and egress mode to and from railway stations. The Willingness to use model does not have any statistically significant variables, although we note that the trip frequency coefficient is close to 10% significance and has the expected sign.

The reported goodness of fit for the WTP-model has a magnitude that is usual with this type of data. It is higher than the goodness of fit for the WTU-model, which can be considered to be quite low (e.g., the independent variables included in the WTU-model explain only 6% of the variation in WTU).

CONCLUSIONS

The market segment for M-Ticket services mainly consists of people who are intensive users of Internet and telecommunication technologies. Young people (males) are overrepresented. As there is a trend for the use of the Internet and mobile phones to spread, there is a potential for growth of use by other age groups. In terms of public transport users, a tendency can be observed that M-ticket services are most attractive for semifrequent public transport users. Infrequent users will find the benefits of M-tickets not worth the effort of registration. On the other hand, frequent users will buy season tickets anyway.

The participants of the NoordNed M-Ticket field study were in general satisfied with the service. The response rate for the questionnaires was high, which can be interpreted as a signal that people were highly involved with the study. The users found the M-Ticket service very convenient and easy to use: no more queuing and waiting.

An important question related to the Voice-portal is: What would be the consequences of charging a price for the free 0800-service? Of the participants, 68% stated they would stop using the M-Ticket service if it cost 25 eurocents per call. The share using the Internet as a means to order electronic tickets was about 30%. Hence, since the Internet alternative did not have the same degree of immediate accessibility compared with the Voice-portal in the Netherlands at the time of the study, there was a clear risk that a substantial part of the customers would not use the M-ticket service once the Voice-portal was no longer provided free of charge. Thus, the overall WTP of customers for M-ticket services must be considered as low. Since the study was carried out, wireless Internet through handheld devices and mobile phones has become widespread, thus offering an alternative with equal accessibility as the Voice-portal.

With regard to possible additional services, services related to travel planning and public transport were the most obvious candidates. We found a standardized WTP of 4.45 eurocents per call for real-time travel-information and 4.55 eurocents for en-route information to the final destination. The overall impression is that it would be difficult to develop additional services as a profit center to make M-ticketing commercially feasible. An Ordinary Least Squares-regression analysis of the WTP for real-time travel-information (Table 9) reveals that it increases with income and with the frequency of mobile phone use. The WTP also depends on travel behavior and the complexity of the journey. The more trips people make and the more transfers people have to make during their trips, the higher their WTP. This

is consistent with findings in other studies. A Heckman sample selection model estimation did not show significantly different outcomes than the OLS-regression.

It must be recognized that the sample size on which this study is based is rather small. This puts some limitations on the decisiveness of our conclusions; however, it must be noted that even with this small number of observations a good number of statistically significant results were obtained.

The failure rate of the Short Message Service (SMS) (M-tickets not being received in time by customers) was 5% in the first part of the study, which was very high for such a service. Clearly, these bad scores must be considered as inevitable risks in this kind of study. During the course of the field study, however, the failure rate fell substantially, which explained why participants did not complain very much about this unreliability in the ex-post valuation.

Communication towards the traveler with regard to the price of an M-ticket compared with regular tickets or a subscription and what to do in case an M-ticket is not received would be an essential element of strategies for the large-scale introduction of this ticket.

At the end of this article, it is interesting to mention that in the time that has elapsed since the completion of the study, major actors in the Netherlands agreed on the nationwide introduction of electronic tickets in the form of smart cards for all transport modes. Both urban and rural areas will be covered by this service. This will entail an introduction trajectory of about three years, but it means that there is no longer any basis for the large-scale introduction of the M-ticket service in the form presented here. The system was, therefore, never fully implemented and marketed to all NoordNed passengers. Meanwhile, the electronic ticketing system still remained available for the NoordNed study participants, although in practice only the more frequent travelers continued to use the service. Also, since the completion of the test, the company that built the mobile ticketing service was reorganized and the database monitoring of the service was altered. For all these reasons, we have not been able to collect additional information and data on the deployment of the technology.

As a consequence of the introduction of the smart card technology, both paper and M-tickets will not be sold anymore, meaning that our research results will not be directly applicable in the new context in the Netherlands. This does not mean to say that our results are not of any practical use. First of all, the results remain important for countries where no smart card system is introduced in public transport. Second, our findings on the WTP for information services are very relevant, also outside the context of the M-ticket service.

In addition, our results are of considerable use for some niche markets where M-tickets are actually used or have the potential to be used. First, the M-ticket service can be nicely combined with ticketing in the case of big events or major tourist attractions. When people make reservations for these events/attractions, the supply of an M-ticket may be offered as an additional service, possibly with a discount and with the provision of information on how exactly to get to the venue concerned. Second, for long-distance transport, where seats have to be reserved, it is an efficient reservation system. For instance, the long-distance rail department of Netherlands Railways (NS International) has also implemented the M-Ticketing system (www.ns.nl/internationaal). The service roughly works the same, the main differences being that the NS M-tickets cannot be cancelled, the customer has to pay using a credit card, and the booking of tickets is confirmed both through the SMS and by email. Otherwise, NS International has not (yet) implemented the Voice-portal: NS International already has a phone service and an online booking shop for ordering international train tickets. The NS system is comparable with electronic ticketing systems in aviation, which are connected to reservation of seats: an M-ticket is valid in second class, but not tied to a specific seat number, just like the routines of low-cost carriers.

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